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(54) **METHOD FOR OPERATING AN ADJUSTING APPARATUS AND MEANS FOR ADJUSTING A POSITIONAL DEVICE**

VERFAHREN ZUM BETRIEB EINER EINSTELLVORRICHTUNG UND MITTEL ZUM EINSTELLEN EINES POSITIONIERSYSTEMS

PROCEDE D'ACTIONNEMENT D'UN APPAREIL DE REGLAGE ET MOYENS DE REGLAGE D'UN DISPOSITIF DE POSITIONNEMENT

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US-A- 1 860 492
US-A- 3 530 346

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EP 0 763 274 B1

Description

Technical field

The present invention relates to a method of operating at least one adjusting/positioning apparatus for an adjustable device, means of operating an adjustable device and an application of the said means.

State of the art

The use of rapid pulses to drive a motor shaft through an electromagnetically vibrated (oscillating) arm mounted on the shaft has long been known. The shaft may be driven reversibly by an arrangement of two electromagnetically vibrated arms (see US-A-1 860 492 and DE-C-349 678).

The use of a ratchet connected to a solenoid or electromagnet energized by an alternating current as a stepping drive for a disc device is also known (see US-A-3 530 346 and CH-C-469 393).

The control of a feeder for handling vibrating material is known from US-A-4 554 490. An optimum speed for conveying material so as to improve the feeding efficiency, reduce noise levels and reduce mechanical wear and tear on the equipment can be achieved by varying strokes and driving frequencies.

A disadvantage of known devices which use pulse-controlled electromagnets is that they use rapid oscillating pulses, a method which is not always suitable for operating adjustable devices, in addition to which the pulse length, frequency and amplitude cannot be varied at different times and at different positions of adjustment.

Summary of invention

The present invention relates to a method and means of using at least one tool to operate an adjusting/positioning apparatus for an adjustable device, the tool being actuated mechanically by a moving element interacting magnetically with an electromagnet.

In accordance with the present invention, there is provided a method using tools to operate an adjusting/positioning apparatus for an adjustable device, **characterized in that** each tool, individually or connected in series or parallel, is actuated mechanically by a moving element which, in turn, interacts magnetically with an electromagnet which can be magnetized by computer-controlled current pulses, whereby the moving element alternates between open positions when the electromagnet is not energized, at selected air gaps relative to the electromagnet, which gaps can be varied by the computer control during the operating sequence, and a closed (attracted) position when the electromagnet is energized, thereby influencing the operation, by the said tools , of the adjusting apparatus in its different directions of operation and/or in its various positions of adjustment, at variable torque/variable speed, in accordance with the computer-controlled current pulses of the electromagnets, respectively.

Further in accordance with the present invention, there are provided means of operating an adjustable device, which means include tools, such as actuating/ratchet devices, arranged to operate an adjusting apparatus, whereby each tool is arranged to be activated mechanically by a moving element interacting magnetically with an electromagnet , the moving element being arranged to alternate between open, non-magnetized positions with air gaps with respect to the electromagnet and a closed (attracted) position, **characterized in that** each electromagnet is arranged to be energized by computer-controlled current pulses, the air gaps of the moving element for different directions of operation and/or different positions of adjustment of the adjusting apparatus being variably controlled by the computer in response to the current pulses, thereby operating the adjusting apparatus , through the tool , at a variable torque/variable speed.

Further in accordance with the present invention, said means are used to operate one or more adjustable devices in a vehicle.

The electromagnet is energized by current pulses controlled by a computer program, the moving element actuating the tool operating adjusting/positioning apparatus in response to the current pulses in order to operate the adjustable device in accordance with the computer program. Several tools may be connected to the adjusting/positioning apparatus separately and/or in series and/or in parallel to operate the adjusting/positioning apparatus in one or the other direction at the specified torque/operating speed for different directions of operation and/or at different positions of adjustment.

The mutually dependent or independent current pulses for the electromagnets in question may be of a fixed or variable frequency, and the moving elements in question may be controlled to assume air gaps of different sizes with respect to the electromagnet under the control of the computer program.

In one embodiment of the invention, the adjusting apparatus consists of a threaded shaft provided with a fastener, such as a nut, to secure the adjusting apparatus to the adjustable device. The tool for operating the adjustable device may consist of an actuating/ratchet device.

The invention relates particularly to the use of the means of operating or positioning one or more adjustable devices in a vehicle, preferably using a single computer to control all of the magnetizing pulses.

Other special features and characteristics are described in the appended patent claims.

The invention is particularly applicable as a small, powerful, slow-acting motor, such as a linear motor, angle motor, stepping motor or suchlike, or as an actuator for operating and adjusting a device, such as turning a shaft, in instances in which solenoids are too fast-acting.

An advantage of the method and means in accordance with the invention, compared with other known adjusting devices, is the wide range of adjustment facilities, in terms of torque and speed of operation, available for different directions of operation, as well as for different adjustment times and positions. This is due to the computer control of the induced magnetizations of the electromagnets, which are determined by several parameters, such as current pulse frequency, pulse amplitude and pulse length, and by the nature of the mutual dependency between the magnetization pulses.

Another advantage is the simple compact construction as well as the reliability of the means in accordance with the invention, which is intended primarily to replace devices, such as servomotors, which are often used with adjustable devices, for example, for window regulators, seats and rear view mirrors in vehicles.

The electromagnet with moving element in accordance with the invention differs from conventional electromagnets with two positions, an open, maximized position and a closed (attracted) position. Thus, for example, the invention makes it possible to choose continuously from a maximum operating speed and the associated minimum torque, to a minimum operating speed and the associated maximum torque. As a further advantage, the invention makes it possible, when positioning, to operate the adjustable device at maximum force and low operating speed initially, then to reduce the force and increase the speed, while using another, optional operating speed/force in the other direction.

Description of an embodiment of the invention

The invention will be described in detail below with reference to the appended drawings, of which

Fig. 1 is a schematic view of a means of operating an adjustable device in accordance with the invention;

Fig. 2 is a schematic illustration of an adjusting apparatus driven by several electromagnetically operated actuating/ratchet devices;

Fig. 3 is a diagram showing the size of the air gap as a function of time;

Fig. 4 is a diagram illustrating the relationship between torque and operating speed at a specified frequency and amplitude.

Fig. 1 shows a moving element 1 made of a magnetic material, which element interacts with an electromagnet 2, the winding of which is supplied with an alternating current. In the embodiment shown, the moving element 1 consists of a pivoted armature, the free end of which can assume a closed position B when the electromagnet is energized by a current, and positions A when the electromagnet is not energized i.e. when no current is flowing in the winding. Positions A are all positions which may be assumed by the moving element 1 when the electromagnet is not energized. The moving element may assume a maximum distance from the electromagnet, with or without the provision of a stop (not shown), while the moving element 1 may move between positions A and position B in step with the current pulses supplied to the electromagnet 2. The moving element 1 and interacting electromagnet 2 may, naturally, be of another optional design, for example a push/pull magnet, suitable for a specific purpose.

Furthermore, the invention may be provided with optional devices (not shown) to pull the moving element 1 into the maximum open position, and to retain it in that position, when the electromagnet 2 is not energized.

In the example shown in Fig. 1, the other end of the moving element 1 mechanically actuates a tool 3 which, in turn, operates an adjusting apparatus 4. The tool 3 may be of an appropriate type, preferably a journalled ratchet, although all types of tractive/ratchet devices, such as a strap, or other bearing arrrangements, may, naturally, also be used.

In the embodiment shown in Fig. 1, the adjusting apparatus 4 consists of a threaded shaft attached to the adjustable device (not shown) by means of a fastener, such as a nut. The shaft is turned in the direction indicated by the arrow.

Fig. 2 illustrates schematically how moving parts 1a, 1b, 1c and 1d may be arranged to actuate corresponding tools 3a, 3b, 3c and 3d, to drive (and lock) the shaft 4 in two different directions, the tools 3a and 3b being arranged to drive the shaft clockwise and the tools 3c and 3d to drive it counterclockwise.

Other types of adjusting apparatus, such as discs, wheels, drums, plates, rods aligned in various directions, and so on, may, naturally, also be used to position/adjust the shaft in one or more dimensions.

Fig. 3 exemplifies the operation of a shaft 4 by moving parts 1a and 1b in combination, in which, at time t_0, the moving part la starts to drive the shaft 4, through tool 3 (not shown), at a low force (large air gap l_0) and, at time t_1, receives assistance from the moving part 1b to drive the shaft at a higher force (smaller air gap l_1), until the moving parts la and 1b reach the closed position B at time t_3.

It will be seen that a device may be operated in an almost unlimited number of ways by varying different parameters, such as the current/pulse frequency, pulse amplitude and pul length, the possible distance between the moving element and the electromagnet, the position and design of the particular moving element/adjusting apparatus, the nature of the electromagnet and winding, the directions of action, and so on.

According to the invention, the frequency, number and magnitude of the current pulses are determined by the program in a computer (not shown in Fig. 1) connected to the winding of the electromagnet 2. Magneti-

zation of the various electromagnets i.e. the order in which they are connected, whether they should be connected in series or parallel or energized individually, or whether they should be mutually energized by dependent or independent current pulses, is controlled by the computer program which, as a result, can provide different operating characteristics for different directions and at different positions of adjustment, and can determine the torque as a function of the air gap. The magnitude of the operating movement achieved by the tool (3) as the moving element switches from the open position A to the closed (attracted) position B is dependent on the size of the air gap which, in turn, is a function of the time during which the electromagnet is not energized.

It will be seen from Fig. 4, together with Fig. 3, that if the current is zero for a longer period (see Fig. 4), the moving, unmagnetized part (1a) will have time to be pulled to have a larger air gap relative to the electromagnet (2), with the result that the shaft 4 will pivoted through a greater distance, at a correspondingly lower torque, in response to the next current pulse while, if the current is zero for a short period (see Fig. 4b), the moving, unmagnetized part (1b) will have insufficient time to move any considerable distance from the closed (attracted) position B and the shaft (4) will only pivot through a short distance in response to the next current pulse, although at a correspondingly higher torque. Specifying the length of the current pulse, at a given frequency and amplitude, affords the option of operating the shaft at high force and low operating speed, or in some other manner.

The means of operating devices may be used to advantage to adjust/operate various devices in a vehicle, such as the window regulators, rear view mirrors, seats, boot lid, doors, (central) locks, sunroof, filler cap, air dampers, and so on, each of which, in addition to operating devices of different kinds, requires a different method of operation in terms of force, speed etc.

A single on-board computer may be programmed to control the current pulses for the various adjustable devices, to ensure optimum adjustment of the devices. Since programming of the computer to perform the various operations is state of the art, it is not dealt with in this description of the invention.

Claims

1. Method using tools (3) to operate an adjusting/positioning apparatus (4) for an adjustable device,
characterized in that each tool (3), individually or connected in series or parallel, is actuated mechanically by a moving element (1) which, in turn, interacts magnetically with an electromagnet (2) which can be magnetized by computer-controlled current pulses, whereby the moving element (1) alternates between open positions when the electromagnet is not energized, at selected air gaps relative to the electromagnet, which gaps can be varied by the computer control during the operating sequence, and a closed (attracted) position when the electromagnet is energized, thereby influencing the operation, by the said tools (3), of the adjusting apparatus (4) in its different directions of operation and/or in its various positions of adjustment, at variable torque/variable speed, in accordance with the computer-controlled current pulses of the electromagnets, respectively.

2. Method in accordance with claim 1,
characterized in that the adjusting apparatus (4) is operated by one or more tools (3) in one direction and that the adjusting apparatus (4) is operated by one or more tools (3) in another direction.

3. Method in accordance with claim 2,
characterized in that the said moving elements (1) are adjusted to their respective positions by current pulses, which differ in terms of frequency and/or amplitude, and which may be dependent on or independent of each other.

4. Method in accordance with claims 1, 2 or 3,
characterized in that the current pulses are of a fixed frequency or a variable frequency.

5. Method in accordance with claims 1-4,
characterized in that the tools (3), respectively, at a specified frequency and amplitude, actuate the adjusting apparatus (4) at a selected torque/operating speed depending on the selected air gap with respect to the electromagnet.

6. Means of operating an adjustable device, which means include tools(3), such as actuating/ratchet devices, arranged to operate an adjusting apparatus (4), whereby each tool (3) is arranged to be activated mechanically by a moving element (1) interacting magnetically with an electromagnet (2), the moving element (1) being arranged to alternate between open, non-magnetized positions with air gaps with respect to the electromagnet and a closed (attracted) position,
characterized in that each electromagnet (2) is arranged to be energized by computer-controlled current pulses, the air gaps of the moving element (1) for different directions of operation and/or different positions of adjustment of the adjusting apparatus (4) being variably controlled by the computer in response to the current pulses, thereby operating the adjusting apparatus (4), through the tool (3), at a variable torque/variable speed.

7. Means in accordance with claim 6,
characterized in that one or more tools (3) is/are

arranged to operate the adjusting apparatus (4) in one direction and that one or more tools (3) is/are arranged to operate the adjusting apparatus (4) in another direction by means of different, mutually dependent or independent current pulses, whereby the said pulses may be of a fixed frequency or a variable frequency.

8. Means in accordance with claims 6-7, **characterized in that** the adjusting apparatus (4) consists of a threaded shaft provided with a fastener, for example a nut, to secure it to the adjustable device.

9. Use of the means in accordance with any of the claims 6-8 to operate one or more adjustable devices in a vehicle.

Patentansprüche

1. Verfahren zur Verwendung von Werkzeugen (3) zum Betrieb eines Einstell-/Positioniergerätes (4) für eine einstellbare Vorrichtung, dadurch **gekennzeichnet**, daß jedes Werkzeug (3), einzeln oder in Reihe oder parallel verbunden, mechanisch durch ein bewegliches Element (1) betätigt wird, das wiederum magnetisch mit einem Elektromagneten (2) in Wechselwirkung steht, der durch computergesteuerte Stromimpulse magnetisiert werden kann, so daß das bewegliche Element (1), wenn der Elektromagnet nicht mit Energie versorgt ist, zwischen offenen Positionen mit ausgewählten Luftspalten relativ zu dem Elektromagneten, welche Spalte durch die Computersteuerung während der Betriebssequenz variiert werden können, und, wenn der Elektromagnet mit Energie versorgt ist, einer geschlossenen (angezogenen) Position wechselt, so daß dadurch der Betrieb des Einstellgerätes (4) durch die Werkzeuge (3) in seine unterschiedlichen Arbeitsrichtungen und/oder in seine unterschiedlichen Einstellpositionen mit variablem Drehmoment/variabler Geschwindigkeit in Übereinstimmung mit den computergesteuerten Stromimpulsen der Elektromagnete jeweils beeinflußt wird.

2. Verfahren nach Anspruch 1, dadurch **gekennzeichnet**, daß das Einstellgerät (4) durch ein oder mehrere Werkzeuge (3) in einer Richtung betrieben wird und daß das Einstellgerät (4) durch ein oder mehrere Werkzeuge (3) in einer anderen Richtung betrieben wird.

3. Verfahren nach Anspruch 2, dadurch **gekennzeichnet**, daß die beweglichen Elemente (1) in ihren jeweiligen Positionen durch Stromimpulse eingestellt werden, die hinsichtlich der Frequenz und/oder Amplitude verschieden sind und die voneinander abhängig oder unabhängig sein können.

4. Verfahren nach Anspruch 1, 2 oder 3, dadurch **gekennzeichnet**, daß die Stromimpulse eine feste Frequenz oder eine variable Frequenz haben.

5. Verfahren nach Anspruch 1 - 4, dadurch **gekennzeichnet**, daß die Werkzeuge (3) jeweils bei einer spezifizierten Frequenz und Amplitude das Einstellgerät (4) mit einem ausgewählten Drehmoment/einer ausgewählten Betriebsgeschwindigkeit in Abhängigkeit von dem ausgewählten Luftspalt relativ zu dem Elektromagneten betätigen.

6. Einrichtung zum Betrieb einer einstellbaren Vorrichtung, welche Einrichtung Werkzeuge (3) enthält, wie etwa Betätigungs-/Ratscheneinrichtungen, die so angeordnet sind, daß sie ein Einstellgerät (4) betätigen, wobei jedes Werkzeug (3) so angeordnet ist, daß es durch ein bewegliches Element (1) mechanisch aktiviert wird, das mit einem Elektromagneten in Wechselwirkung steht, wobei das bewegliche Element (1) so angeordnet ist, daß es zwischen offenen, nicht magnetisierten Positionen mit Luftspalten relativ zu dem Elektromagneten und einer geschlossenen (angezogenen) Position wechselt, dadurch **gekennzeichnet**, daß jeder Elektromagnet (2) so ausgelegt ist, daß er durch computergesteuerte Stromimpulse mit Energie versorgt wird, wobei die Luftspalte des beweglichen Elements (1) für unterschiedliche Betriebsrichtungen und/oder unterschiedliche Einstellpositionen des Einstellgeräts (4) von dem Computer ansprechend auf die Stromimpulse variabel gesteuert werden, so daß dadurch das Einstellgerät (4) durch das Werkzeug (3) mit variablem Drehmoment/variabler Geschwindigkeit betrieben wird.

7. Einrichtung nach Anspruch 6, dadurch **gekennzeichnet**, daß ein Werkzeug oder mehrere Werkzeuge (3) so ausgelegt ist bzw. sind, daß es bzw. sie das Einstellgerät (4) in eine Richtung betreiben, und daß ein Werkzeug oder mehrere Werkzeuge (3) so ausgelegt ist bzw. sind, daß es bzw. sie das Einstellgerät (4) in eine andere Richtung betreiben, und zwar mittels verschiedener, voneinander gegenseitig abhängiger oder unabhängiger Stromimpulse, wobei die Impulse eine festgelegte Frequenz oder eine variable Frequenz haben können.

8. Einrichtung nach Anspruch 6 - 7, dadurch **gekennzeichnet**, daß das Einstellgerät

aus einer Gewindewelle besteht, die mit einer Halteeinrichtung , beispielsweise einer Mutter, versehen ist, um sie an der einstellbaren Vorrichtung zu befestigen.

9. Verwendung der Einrichtung nach einem der Ansprüche 6 - 8, um eine oder mehrere einstellbare Vorrichtungen in einem Fahrzeug zu betreiben.

Revendications

1. Procédé utilisant des outils (3) pour faire fonctionner un appareil de réglage/positionnement (4) pour un dispositif réglable,
caractérisé en ce que chaque outil (3), individuellement ou relié en série ou en parallèle, est actionné de manière mécanique par un élément mobile (1) qui, à son tour, interagit de manière magnétique avec un électroaimant (2) qui peut être magnétisé par des impulsions de courant commandées par ordinateur, de sorte que l'élément mobile (1) se déplace en va-et-vient entre des positions ouvertes où l'électroaimant n'est pas excité, au niveau d'entrefers choisis par rapport à l'électroaimant, entrefers qui peuvent être amenés à varier par la commande d'un ordinateur au cours de la séquence de fonctionnement, et une position fermée (attirée) où l'électroaimant est excité, en influençant ainsi le fonctionnement, par lesdits outils (3), de l'appareil de réglage (4) dans ses différentes directions de fonctionnement et/ou dans ses diverses positions de réglage, à un couple variable/une vitesse variable, conformément aux impulsions de courant commandée par ordinateur des électroaimants, respectivement.

2. Procédé selon la revendication 1,
caractérisé en ce que l'appareil de réglage (4) est amené à fonctionner par un ou plusieurs outils (3) dans une première direction et en ce que l'appareil de réglage (4) est amené à fonctionner par un ou plusieurs outils (3) dans une autre direction.

3. Procédé selon la revendication 2,
caractérisée en ce que lesdits éléments mobiles (1) sont réglés à leurs positions respectives par des impulsions de courant, lesquels différent en termes de fréquence et/ou d'amplitude, et peuvent être dépendantes ou indépendantes l'une de l'autre.

4. Procédé selon les revendications 1, 2 ou 3,
caractérisé en ce que les impulsions de courant sont d'une fréquence fixe ou d'une fréquence variable,

5. Procédé selon les revendications 1 à 4,
caractérisé en ce que les outils (3), respectivement, à une fréquence et à une amplitude spécifiée, actionnent l'appareil de réglage (4) à un couple choisi/une vitesse de fonctionnement choisie selon l'entrefer choisi par rapport à l'électroaimant.

6. Moyens pour faire fonctionner un dispositif réglable, moyens qui comprennent des outils (3), tels que des dispositifs d'actionnement/d'encliquetage, montés pour faire fonctionner un appareil de réglage (4), de sorte que chaque outil (3) est monté pour être actionné de manière mécanique par un élément mobile (1) interagissant de manière magnétique avec un électroaimant (2), l'élément mobile (1) étant monté pour se déplacer en va-et-vient entre des positions ouvertes, non magnétisées, avec des entrefers par rapport à l'électroaimant et une position fermée (attirée),
caractérisés en ce que chaque électroaimant (2) est monté pour être excité par des impulsions de courant commandées par ordinateur, les entrefers de l'élément mobile (1) pour différentes directions de fonctionnement et/ou différentes positions de réglage de l'appareil de réglage (4) étant commandés de manière variable par l'ordinateur en réponse aux impulsions de courant, en faisant ainsi fonctionner l'appareil de réglage (4), par l'intermédiaire de l'outil (3),) un couple variable/une vitesse variable.

7. Moyens selon la revendication 6,
caractérisés en ce qu'un ou plusieurs outils (3) est/sont monté(s) pour faire fonctionner l'appareil de réglage (4) dans une première direction et en ce qu'un ou plusieurs outils (3) est/sont monté(s) pour faire fonctionner l'appareil de réglage (4) dans une autre direction au moyen de différentes impulsions de courant, mutuellement dépendantes ou indépendantes, de sone que lesdites impulsions peuvent être d'une fréquence fixe ou d'une fréquence variable.

8. Moyens selon les revendications 6 à 7,
caractérisés en ce que l'appareil de réglage (4) se compose d'un arbre fileté muni d'un organe de fixation, par exemple un écrou, pour le fixer au dispositif réglable.

9. Utilisation des moyens selon une quelconque des revendications 6 à 8 pour faire fonctionner un ou plusieurs dispositifs réglables d'un véhicule.

Fig.1

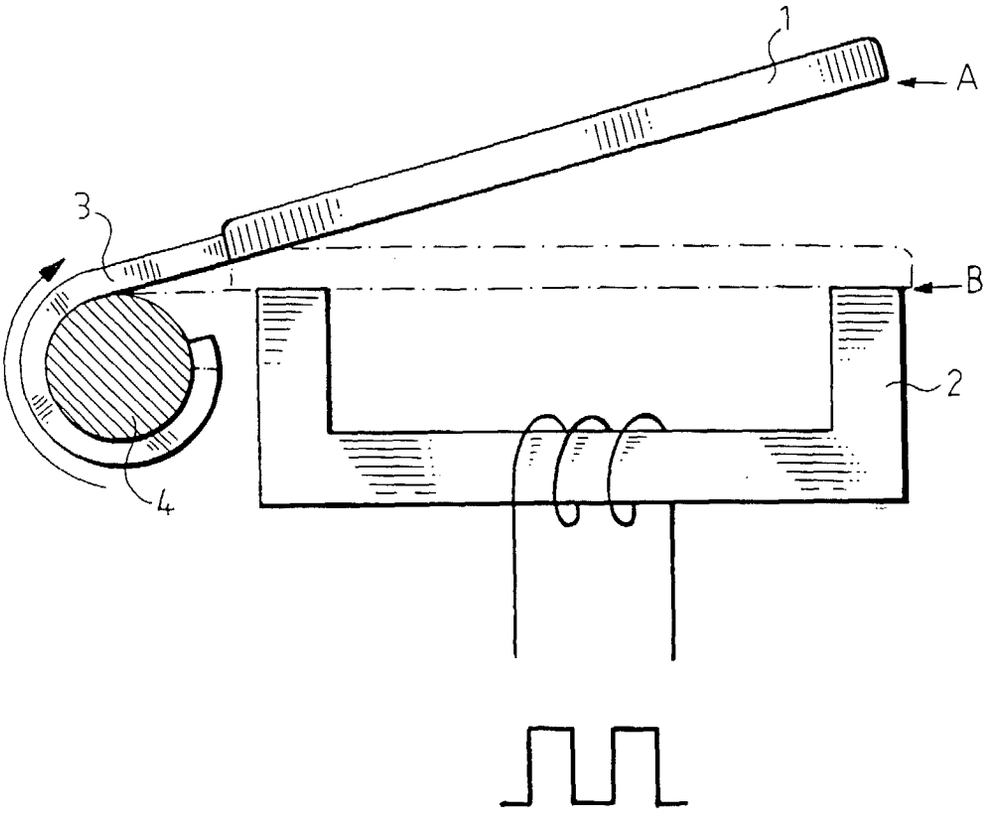


Fig.2

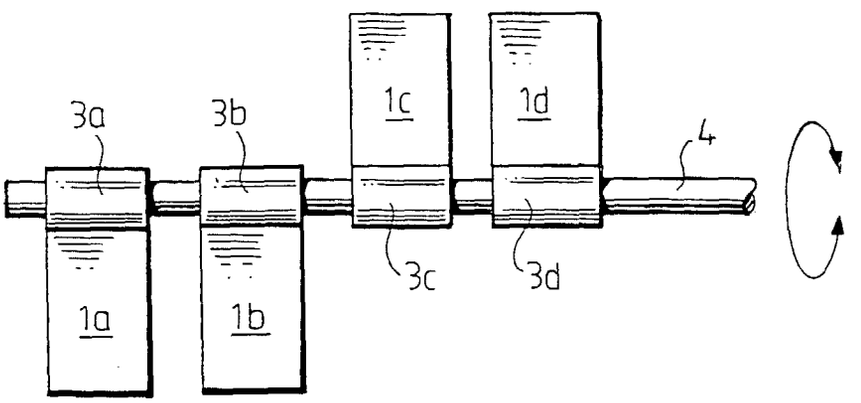


Fig. 3

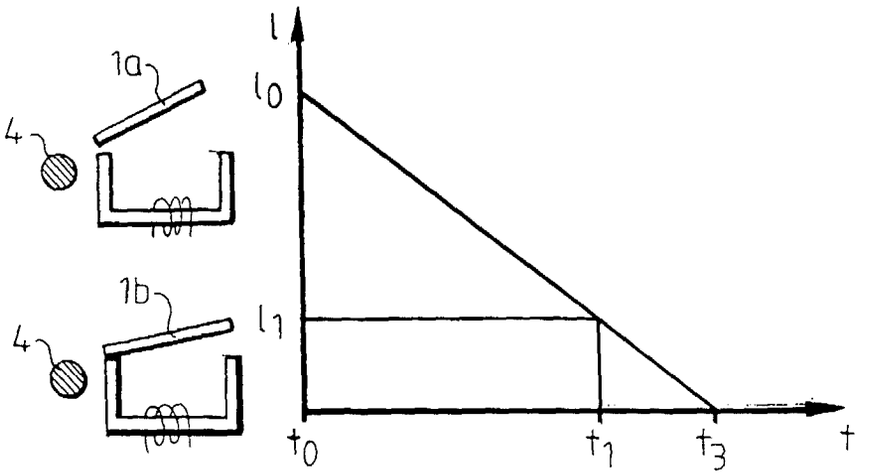


Fig. 4a



Fig. 4b

